

IN THE SUMMARY OF THE INVENTION:

Please delete the text at page 2, line 17 through page 2, line 25 and insert the following in lieu thereof:

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According to the invention, a cementitious composition includes about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate, about 10 wt.% to about 50 wt.% Portland cement, about 4 wt.% to about 20 wt.% silica fume and about 1 wt.% to about 50 wt.% pozzolanic aggregate. The Portland cement component may also be a blend of Portland cement with fly ash and/or ground blast slag. The invention further includes construction compositions and materials made from the inventive cementitious composition.

IN THE DETAILED DESCRIPTION OF THE INVENTION:

Please delete the text starting at page 3, line 16 through page 5, line 39 and insert the following in lieu thereof:

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Compositions according to the invention include about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate (i.e., beta-gypsum), about 10 wt.% to about 50 wt.% Portland cement (Type III is preferred), about 4 wt.% to about 20 wt.% silica fume, and about 1 wt.% to about 50 wt.% pozzolanic aggregate as filler.

The beta-gypsum component of the inventive composition is calcium sulfate beta hemihydrate, commonly referred to as stucco. Beta-gypsum is traditionally less expensive than alpha-gypsum. Alpha-hemihydrate powder has a higher apparent density and smaller related surface area than beta-hemihydrate, resulting in a lower water

requirement for the same workability and a higher compressive strength of the set material. However, boards made from the inventive composition have exhibited more than adequate strength for interior applications such as backer boards and floor underlays and exterior applications, such as exterior sheeting and eaves.

The Portland cement component of the composition according to the invention may be any of Types I, II, III, IV, or IV (or mixtures thereof) as set forth according to ASTM standards. However, Type III Portland cement is preferred. Type III Portland cement cures faster than Type I and Type II Portland cement and exhibits an early high strength.

Blended cements also may be used in compositions according to the invention. Blended cements are blends of Portland cement with one or more pozzolanic materials such as fly ash and blast-furnace slag. The pozzolanic materials that are added to produce a "blend" with Portland cement are distinguished from the pozzolanic aggregate filler component according to the invention of the application in that the components of the cement "blend" have a particle size which is in the same range as the particle size range of Portland cement. Portland cement particle size may be defined as having approximately 15% of the particles retained on a 325 mesh screen. In other words, at least 85% of the Portland cement particles pass through a 325 mesh screen (allows particles having a diameter of up to 45 microns to pass through). Thus, for example, blast furnace slag and certain fly ash must be ground prior to mixing with Portland cement to result in a "blend" for use in the invention.

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The silica fume component of compositions according to the invention is an extremely active pozzolan

and prevents the formation of ettringite. Silica fume is very fine (particle average diameter of between about 0.1 microns and about 0.3 microns), has a high surface area (between about 20 meter²/gram and about 30 meter²/gram), and is highly amorphous (between about 98 wt.% and about 100 wt.% amorphous SiO₂ (glassy material)).

The pozzolanic aggregate filler component of compositions according to the invention may be a natural or man-made filler that contains a high percentage of amorphous silica. Natural pozzolanic aggregates are of volcanic origin and include trass, pumice, and perlite. Man-made pozzolanic aggregate fillers include fly ash and FILLITE (hollow silicate spheres which may be made from fly ash; produced by Fillite Division of Boliden Intertrade, Inc. Atlanta, Georgia). As compared to cement "blend" components of the invention, pozzolanic aggregates used as fillers according to the invention are defined herein as having an average particle size larger than that of Portland cement (i.e., average particle size larger than 45 microns).

Pozzolanic aggregate fillers contain a high percentage of amorphous silica which possesses little or no cementitious properties. However, in the presence of moisture, pozzolanic aggregates have surfaces that are chemically reactive with calcium hydroxide at standard temperatures to form hydrated calcium silicate (CSH) which, in compositions and methods according to the invention, are believed to become a homogeneous part of a cementitious system due also to the presence of the finely divided pozzolan of the invention, silica fume. Compositions according to the invention which include both a pozzolanic aggregate and a finely divided pozzolan result in cementitious materials wherein the transition zone between

the aggregate and a cement paste is densified and thus produces a cured product of higher compressive strength than compositions which utilize a pozzolanic aggregate alone or a finely divided pozzolan alone. It is believed that the mechanism which causes changes in the microstructure of compositions according to the invention to result in higher compressive strengths is associated with two effects: a pozzolanic effect and a micro-filler effect (due to the fine size and spherical shape of the silica fume).

Compositions for construction materials such as backer boards and floor underlays according to the invention preferably include about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate (about 30 wt.% to about 50 wt.% is preferred), about 10 wt.% to about 50 wt.% Portland cement (about 6 wt.% to about 35 wt.% is preferred), about 4 wt.% to about 20 wt.% silica fume (about 4 wt.% to about 10 wt.% is preferred), and about 10 wt.% to about 50 wt.% a pozzolanic aggregate filler (about 25 wt.% to about 35 wt.% is preferred). A preferred aggregate filler for use in such construction materials is pumice. Pumice is desirable as it is relatively light weight and can be sized to result in a product of desirable strength and physical properties. For example, Hess Pumice Products Inc. manufactures a size No. 10 pumice aggregate that measures about 93% greater than 1400 microns, while the size No. 5 pumice aggregate has a particle size measurement of about 23% greater than 1400 microns.

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Although fillers such as calcium carbonate, crystalline silica and different types of clay could be included in the composition, it has been found that the use of a pozzolanic aggregate filler results in a product according to the invention having superior properties. As

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explained above, this is believed to occur because the surfaces of the pozzolanic aggregate filler react with free lime to form hydrated calcium silicate (pozzolanic reaction) which becomes part of the product matrix. Such a reaction is only possible with pozzolanic aggregate fillers.

The composition according to the invention produces building materials which set up quickly, exhibit high strength and durability, and are water resistant.

Gypsum boards produced from compositions according to the invention may be produced on a continuous line. Because the composition according to the invention sets up quickly (typically in three minutes or less), building materials made from the composition can be handled (e.g. sheets can be cut into smaller sheets or boards) much faster than products made from Portland cement alone. Unlike traditional gypsum board, boards or other products made from a composition according to the invention do not require kiln drying, and in fact, kiln drying should be avoided. ~

Page 6, line 11, after "pozzolanic" insert
--aggregate--.

Please delete page 7, line 5 through page 9, line 25 and insert the following in lieu thereof:

-in an acceptable product. However, this may extend the curing time. A board according to the invention usually substantially reaches its full strength about fourteen to about twenty-eight days after formation.

When preparing a board or other product according to the invention, the forced drying required for gypsum board should be avoided. An alternative curing procedure is

to cover or wrap the boards in plastic wrapping for about three days to retain moisture for continuous curing. Such covered boards have exhibited about 50% higher strength than normal gypsum boards of the same density. Also, the covered boards develop about 70% to about 80% of their ultimate strength in three days.

When a board or other product having a thickness of about 1/8 inch is desired, the cementitious composition thereof preferably includes about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate, about 10 wt.% to about 50 wt.% Portland cement, about 4 wt.% to about 20 wt.% silica fume, and about 1 wt.% to about 50 wt.% pozzolanic aggregate filler, resulting in a very strong thin product, especially useful, for example, for floor underlays. A preferred cementitious composition for use in very thin boards (i.e. about 1/8 inch) and floor underlays includes about 70 wt.% to about 75 wt.% calcium sulfate beta hemihydrate (about 74 wt.% is particularly preferred), about 15 wt.% to about 40 wt.% Portland cement (about 35 wt.% is particularly preferred), about 4 wt.% to about 10 wt.% silica fume (about 10 wt.% is particularly preferred), and about 1 wt.% to about 25 wt.% pozzolanic filler.

Compositions according to the invention may also be used to prepare self-leveling floor compositions and road patching materials. In such materials, a master blend composition according to the invention is prepared which includes about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate (i.e. beta-gypsum) (about 30 wt.% to about 50 wt.% is preferred), about 10 wt.% to about 50 wt.% Portland cement (about 6 wt.% to about 25 wt.% is preferred), about 4 wt.% to about 20 wt.% silica fume (about 4 wt.% to about 8 wt.% is preferred), and about 1

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wt.% to about 50 wt.% a pozzolanic aggregate filler (about 1 wt.% to about 15 wt.% is preferred; about 1 wt.% to about 5 wt.% particularly preferred). The master blend is then mixed with silica aggregates (i.e., predominately quartz local sand) to form the floor or road patching material.

Preferably, a self-leveling floor composition according to the invention includes (i) about 25 wt.% to about 75 wt.% of the master blend; and (ii) about 75 wt.% to about 25 wt.% sand. Most preferably, a self-leveling floor composition master blend includes about 71 wt.% calcium sulfate beta-hemihydrate, about 20 wt.% Portland cement, about 6 wt.% silica fume and about 2 wt.% FILLITE pozzolanic filler. Because of its low density, FILLITE addition of amounts as low as about 1 wt.% of the composition provide a considerable volume of filler (see Example 2, Table II for FILLITE physical properties).

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A road patching composition according to the invention includes (i) about 25 wt.% to about 100 wt.% of the master blend described herein with respect to the self-leveling floor compositions of the invention; and (ii) about 75 wt.% to about 0 wt.% sand.

Compositions according to the invention may also be used in fiberboards according to the invention. Such fiberboards include (i) about 70 wt.% to about 90 wt.% of the master blend described herein with respect to the self-leveling floor compositions and road patching compositions of the invention; and (ii) about 30 wt.% to about 10 wt.% of a fiber component. The fiber component is preferably selected from the following: wood fibers, paper fibers, glass fibers, polyethylene fibers, polypropylene fibers, nylon fibers, and other plastic fibers.

Most preferably, a master blend according to the invention for use in such a fiberboard includes about 74 wt.% calcium sulfate beta-hemihydrate, about 20 wt.% Portland cement, and about 6 wt.% silica fume.

Fire-proofing sprays and fire-stopping materials may also be prepared utilizing compositions according to the invention. Such fire-proofing and fire-stopping materials include about 20 wt.% to about 75 wt.% calcium sulfate beta-hemihydrate (about 30 wt.% to about 50 wt.% is preferred), about 10 wt.% to about 50 wt.% Portland cement (about 10 wt.% to about 25 wt.% is preferred), about 4 wt.% to about 20 wt.% silica fume (about 4 wt.% to about 10 wt.% is preferred), and about 1 wt.% to about 50 wt.% a pozzolanic aggregate filler (about 1 wt.% to about 10 wt.% is preferred). Preferably, the pozzolanic filler is FILLITE or perlite or mixtures thereof. Fire-proofing sprays and fire-stopping materials according to the invention also preferably include about 1 wt.% to about 30 wt.% unexpanded vermiculite filler. Such fire-proofing and fire-stopping materials may also include up to about 2 wt.% glass fibers and up to about 2 wt.% of a thickening agent. The thickening agent is preferably selected from the following: cellulose derivatives, acrylic resins and mixtures thereof. *rr*

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Page 11, line 10, delete "Fillite" and insert

--FILLITE-- in lieu thereof.

Page 11, line 25, after "microns." please insert

-The shell composition includes 27 wt.% to 33 wt.% Al_2O_3 ,
55 wt.% to 65 wt.% SiO_2 , and a maximum of 4 wt.% Fe_2O_3 .

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Page 13, line 41, after "cement paste." please
insert the following new example:

EXAMPLE 4

A cementitious master blend binder according to
the invention was prepared with the components set forth in
the amounts stated in Table IV below:

TABLE IV

| <u>Material</u> | <u>Approx. Weight Percent</u> |
|--------------------------|-------------------------------|
| Beta-gypsum (Stucco) | 40 |
| Type III Portland Cement | 46 |
| Silica Fume | 14 |
| Accelerator ¹ | 0.35 |

¹ BMA (board milling accelerator, a fine-ground gypsum produced by National Gypsum Company).

The materials identified in Table IV were mixed to form the master blend binder. Then, about 75 wt.% of the binder was mixed with about 25 wt.% pumice aggregate (Hess Products, Inc., Malard City, Idaho) and 100 grams thereof was mixed with 43 grams of water. To improve the workability of the mixture, a water reducing agent (lignosulfonates and/or naphthalene sulfonates manufactured by Georgia Pacific Corp. and Henkel Corp., respectively) was added. The mixture was then formed into two-inch by two-inch (2" x 2") cubes to evaluate strength gain over the time lapse of twenty-eight days. The cubes were sealed in a plastic bag and kept at room temperature (about 25°C).

For the purpose of comparison, about 75 wt.% of the master blend binder of Table IV was mixed with about 25 wt.% of CaCO₂, a non-pozzolanic aggregate having about the same particle size as the pumice, and 100 grams thereof was

mixed with 44 grams of water. This mixture also was formed into two-inch by two-inch (2" x 2") cubes to evaluate strength gain over the time lapse of twenty-eight days. The cubes were sealed in a plastic bag and kept at room temperature (about 25°C).

The density and wet compressive strengths for the samples made according to the invention and the comparative samples made with CaCO₃ were measured and are shown in Table V below:

TABLE V

| Time Elapsed Days | Sample Made With Pozzolanic Aggregate | | Sample Made With Non- Pozzolanic Aggregate | |
|-------------------------|--|---|---|---|
| | Density ¹ | Wet Compressive Strength ² | Density ¹ | Wet Compressive Strength ² |
| 1 | 79.8 | 1151 | 87.0 | 725 |
| 3 | 83.3 | 1779 | 88.9 | 1329 |
| 7 | 83.3 | 2646 | 92.6 | 2155 |
| 28 | 84.8 | 4267 | 92.8 | 3983 |

¹ Pounds/cubic foot.

² Pounds/square inch.

Table V illustrates the acceptable weight strength development of the samples made from a composition according to the invention.

A second test was performed on the composition made from 75 wt.% master blend binder of Table IV and the pumice aggregate to study durability. A four and one-half inch (4 1/2") diameter, one-half inch (1/2") thick patty of the composition was placed under running water for a period of two months. No deterioration of the patty was visible and the total weight loss of the patty after the two-month test was 0.5%.